



## Redescription, lectotype designation and new records of *Anastrepha luederwaldti* Lima (Diptera, Tephritidae)

KEIKO URAMOTO<sup>1</sup>, ALLEN L. NORRBOM<sup>2</sup> & ROBERTO A. ZUCCHI<sup>1</sup>

<sup>1</sup>Departamento de Entomologia e Acarologia, ESALQ, Universidade de São Paulo, Caixa Postal 9, 13418-900 Piracicaba, SP.  
E-mail: uramoto@usp.br; razucchi@usp.br

<sup>2</sup>Systematic Entomology Laboratory, USDA, ARS, c/o Smithsonian Institution, P.O. Box 37012, MRC 168, Washington, DC 20013-7012, USA. E-mail: allen.norrbom@ars.usda.gov

### Abstract

The previously poorly known species *Anastrepha luederwaldti* Lima, 1934 is redescribed based on a reexamination of the syntypes from São Paulo and additional specimens from Santa Catarina and Rio Grande do Sul, Brazil. A lectotype is designated.

**Key words:** Diptera, Tephritidae

The genus *Anastrepha* Schiner, 1868 comprises almost 300 known species distributed in the American tropics and subtropics (Norrbom *et al.* 2015). Although some species are frequently collected, particularly those that are economically important, others are recovered rarely. For various species of *Anastrepha*, the only taxonomic information is based on the type specimens, and for some of these species, the original descriptions are very brief. In this study we redescribe one such species, *A. luederwaldti* Lima, 1934, previously known only from two syntypes from São Paulo state in Brazil. It is redescribed and illustrated in more detail and new distribution records are provided.

### Materials and methods

We follow the morphological terminology of White *et al.* (1999), except for the wing venation, which follows that of the forthcoming *Manual of Afrotropical Diptera* based on Wootton & Ennos (1989) and Saigusa (2006). See Norrbom *et al.* (2012) for explanations and illustrations of characters and their measurement.

Acronyms for the institutions where examined specimens are deposited include: AMNH—American Museum of Natural History, New York; BMNH—The Natural History Museum, London; ESALQ—Escola Superior Agrícola “Luiz de Queiroz”, Universidade de São Paulo, Piracicaba; MZUSP—Museu de Zoologia da Universidade de São Paulo, São Paulo; and USNM—National Museum of Natural History, Smithsonian Institution, Washington, DC.

### *Anastrepha luederwaldti* Lima

*Anastrepha luederwaldti* Lima 1934: 510 [description]; Steyskal 1977: 33 [list]; Norrbom 1985: 182 [classification]; Norrbom *et al.* 1999a: 80 [catalog], 1999b: 334 [classification]; Zucchi 2000: 21 [in key].

*Lucumaphila luederwaldti*: Stone 1939: 342 [new combination]; Aczél 1950: 235 [catalog]; Foote 1967: 30 [catalog].

*Anastrepha* sp. nr. *luederwaldti*: Norrbom 1985: 183 [description, Santa Catarina]; Norrbom *et al.* 1999b: 321, 334 [classification]; Uramoto & Zucchi 1999: 88 [in key].

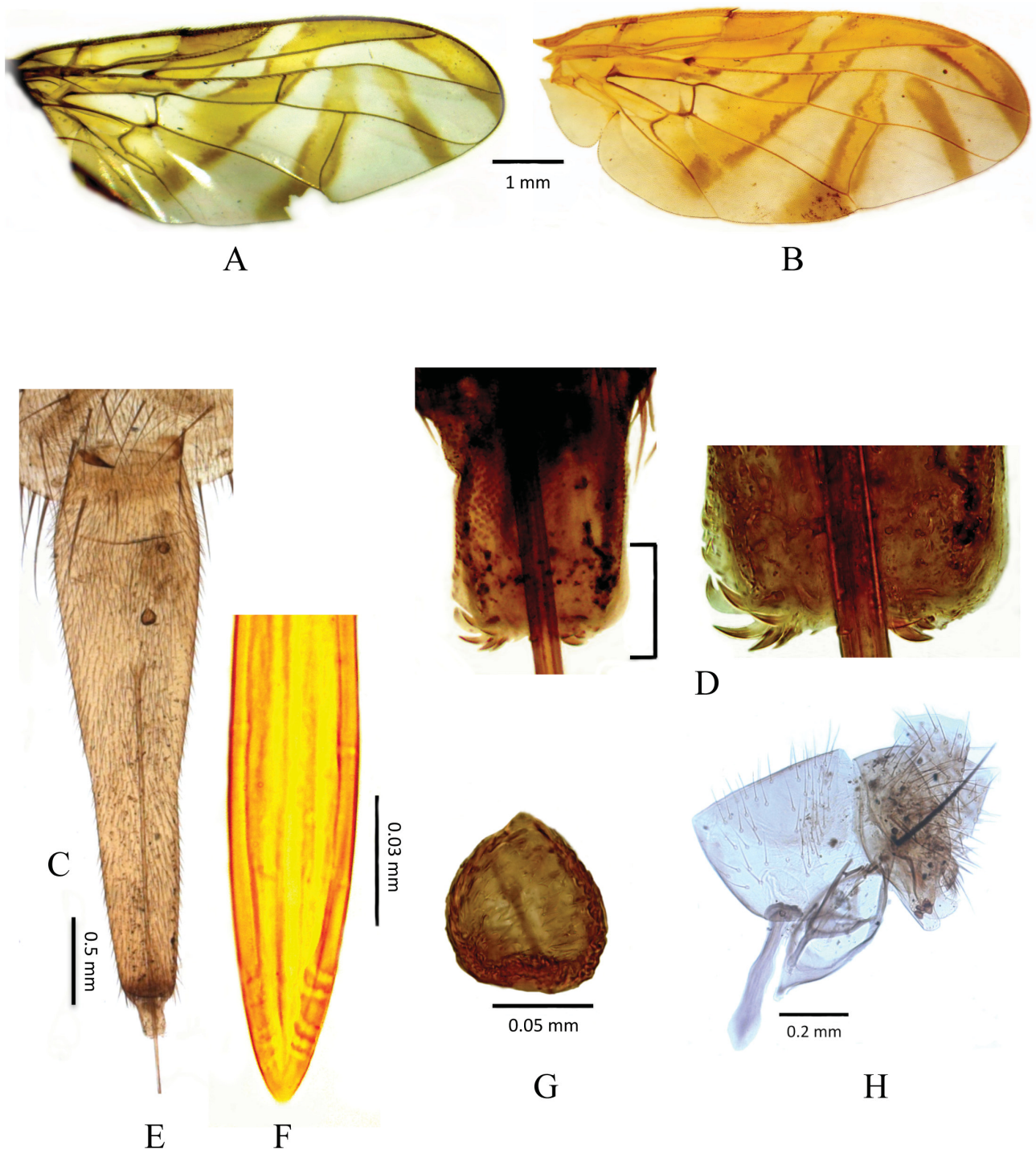
*Anastrepha* aff. *luederwaldti*: Kovaleski *et al.* 1999: 232 [Rio Grande do Sul].

*Anastrepha* sp. prox. *luederwaldti*: Kovaleski *et al.* 2000: 290 [Rio Grande do Sul].

**Diagnosis.** This species can be recognized from most species of *Anastrepha* by having a pair of ovoid brown spots on the posterior margin of the scutum on or slightly lateral to dorsocentral line. It differs from other species of the *punctata*

group, which have that character, in its larger size (mesonotum length 3.40–4.01 mm, wing length 7.92–8.64 mm) and longer terminalia (oviscape length 3.08–3.70 mm vs. less than 2.75 mm). It further differs from *A. punctata* Hendel and *A. aczeli* Blanchard in lacking brown markings on the abdominal tergites (variable in *A. aczeli*), and from *A. morvasi* Uramoto & Zucchi in having the V-band separate from the S-band and lacking serrations on the aculeus tip. In some specimens the scutal brown spots are faint, but those and other specimens can be distinguished from other *Anastrepha* species by the following combination of characters: subscutellum and mediotergite entirely yellow to orange; setae golden to orange; wing with C- and S-bands separated; vein  $R_{2+3}$  not sinuous; vein  $M_1$  weakly curved apically; oviscape length 3.08–3.70 mm, 0.83–1.04 times as long as mesonotum; eversible membrane with gap of weakly sclerotized denticles; and aculeus tip 0.02–0.03 mm wide, not serrate.

**Description.** Mostly yellow to orange. Setae golden to orange.



**FIGURE 1.** A–G. *Anastrepha luederwaldti* (types). A, wing (lectotype female); B, wing (paralectotype male); C, oviscape; D, eversible membrane; E, aculeus partially everted; F, aculeus tip; G, spermatheca; H, male terminalia, lateral.

Head. Yellow to orange except brown to blackish ocellar tubercle. Facial carina relatively weak, in profile, concave on dorsal three-fourths; 3–6 frontal setae (4–5 in lectotype); 2 orbital setae, posterior seta slightly more slender than anterior one; ocellar seta weak, small, 1.0–1.3 times length of ocellar tubercle. Antenna not extended to ventral margin of face. Palpus in lateral view dorsally curved, evenly setulose.

Thorax. Integument mostly yellow to orange. Scutum on posterior margin with pair of small, faint to moderate brown spots or markings anterior to corner of scutellum (on dorsocentral line or between it and intra-alar line). Scuto-scutellar suture without distinct band or medial spot, but sometimes slightly darker orange brown medially. Postpronotal seta on posterior half of postpronotal lobe. Mesopleuron mostly yellow to orange, without brown markings. Normal pale markings poorly differentiated in examined specimens; postpronotal lobe, dorsal margin of anepisternum, postsutural sublateral scutal vitta, and scutellum clearly white to pale yellow in some specimens. Subscutellum and mediotergite entirely yellow to orange. Mesonotum 3.40–4.01 mm long; 2.2–2.5 mm wide. Postpronotal lobe, scutum and scutellum entirely microtrichose. Scutal setulae yellowish. Chaetotaxy typical for genus. Acrostichal, dorsocentral and intra-alar setae well developed. Katepisternal seta well developed, three-fifths as large as anepisternal seta and as large and stout as anepimeral seta, and same in color. Legs entirely yellow to orange. Fore femur with posterodorsal and ventral rows of well developed setae.

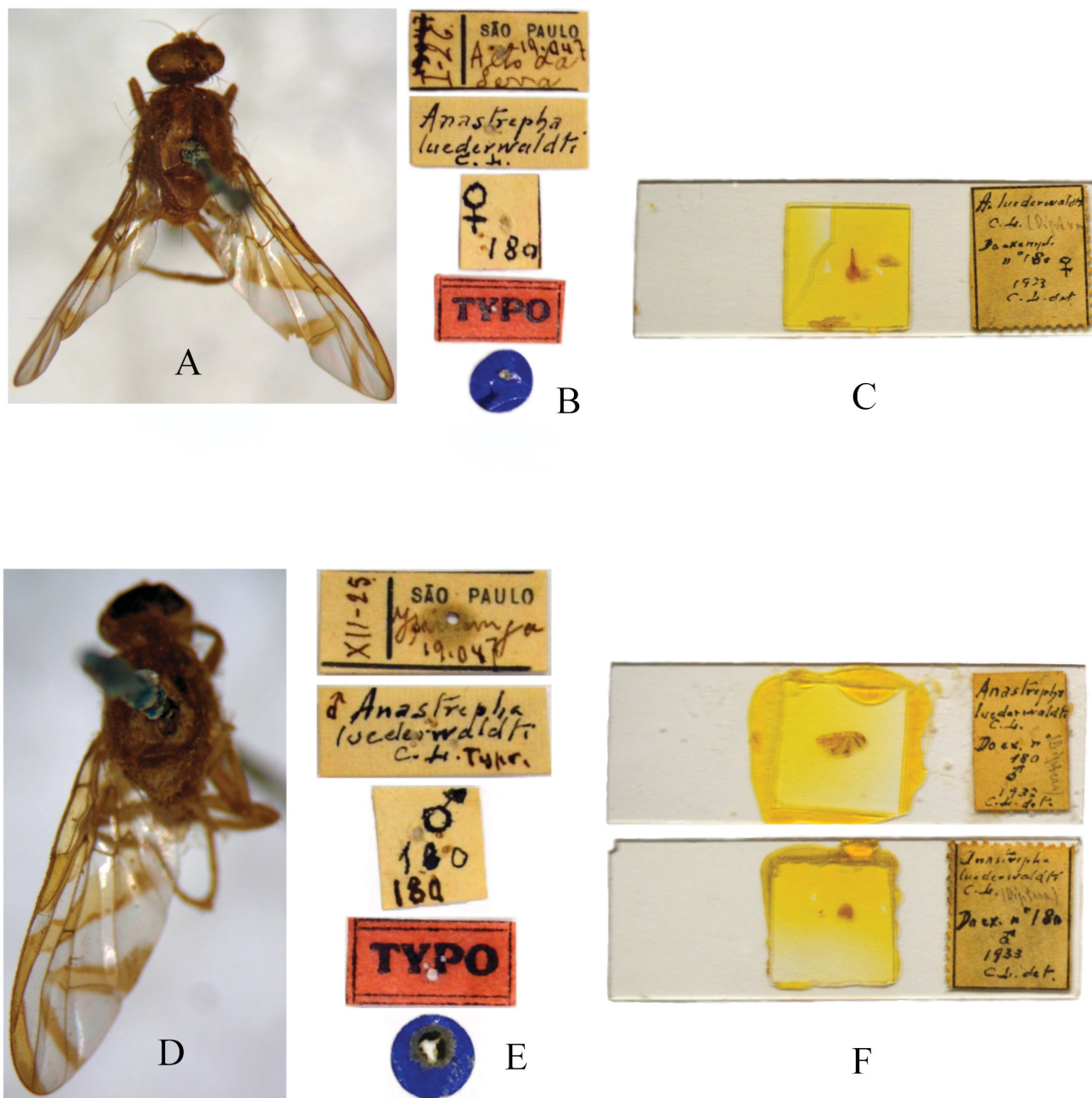


**FIGURE 2.** *Anastrepha luederwaldti* (Brazil: Nova Teutonia). A, wing; B, ovipositor; C, eversible membrane, dorsal; D, aculeus; E, aculeus tip, ventral.

Wing (Figs. 1A–B, 2A). Length 7.92–8.64 mm, width 3.19–3.60 mm, ratio 2.38–2.49. Apex of vein  $R_1$  at 0.54–0.57 wing length, proximal to level of anterior end of crossvein r-m. Cell c 1.16–1.31 times as long as pterostigma; pterostigma 3.71–4.13 times as long as wide. Ratio of costa length between apices of Sc and  $R_1$ /length between apices of  $R_1$  and  $R_{2+3}$  0.51–0.55. Vein  $R_{2+3}$  not sinuous. Crossvein r-m at 0.61–0.69 distance from bm-m to dm-m on vein  $M_1$ . Vein  $M_1$  weakly curved apically; cell  $r_{4+5}$  0.99–1.12 times as wide at apex as at level of dm-m. Cell cua with distal lobe moderately long, length of cua 1.57–1.65 times as long as anterior margin, lobe 0.71–0.92 times as long as vein CuA+CuP. Veins brown or orange. Pattern mostly orange and moderate brown. C-band broadly extending to vein M in cell br along cell bm; covering base of cell  $r_{2+3}$ ; mostly orange, cell c without hyaline area, pterostigma mostly darker



orange brown, distal margin in cells  $r_1$  and  $r_{2+3}$  narrowly brown, and fork of Rs and margin of band in cell br with small brown spots, that in br paler than that on fork of Rs. C-band and S-band broadly separated by hyaline band from cell bm to costal margin, narrowest along vein  $R_{2+3}$  or vein  $R_{4+5}$ . Cell bm entirely hyaline. S-band posterior margin with weak or no incision in cell  $m_4$ . S-band base without extension in middle of cell  $cu_1$  to posterior wing margin; without posterior extension in cell  $a_1$ . S-band middle section predominantly orange with brown margins. S-band distally not extended to apex of vein  $M_1$ ; medium width, at apex of vein  $R_{2+3}$  0.53–0.67 times width of cell  $r_{2+3}$ ; without marginal hyaline marks. Subapical hyaline area in radial cells distal to r-m extending anteriorly to vein  $R_{2+3}$ . V-band proximal arm on posterior wing margin extending three-fifths to four-fifths distance from apex of vein  $M_4$  to apex of vein  $CuA+CuP$ ; anteriorly extended to vein  $R_{4+5}$ , not connected to S-band; distal arm extended to or almost to  $R_{4+5}$ ; broadly or narrowly connected to proximal arm or separate (paralectotype). Area surrounding apex of lobe of cell cua with microtrichia similar in density to area anterodistal to it along vein  $M_4$ . Area between S-band and V-band entirely microtrichose in cells dm and  $m_4$ .



**FIGURE 3.** *Anastrepha luederwaldti*. A–C, lectotype; A, female; B, labels. C, microscope slide. D–F, paralectotype; D, male; E, labels; F, microscope slides.

Abdomen. Pale brown to orange. Tergites without brown markings, entirely microtrichose; setulae pale brown.

Female terminalia. Oviscape (Figs. 1C, 2B) entirely yellow to orange brown; straight and broadened on basal half, apex slender; entirely microtrichose; 3.08–3.70 mm long; length ratio (oviscape length/mesonotum length) 0.83–1.04; spiracle at basal 0.20–0.23. Eversible membrane (Figs. 1D, 2C) with 17–20 relatively short hooklike sclerotized dorsobasal denticles in 2 irregular rows apically and similar number of smaller and weaker more proximal denticles. Aculeus (Figs. 1E, 2D) in ventral view more or less parallel-sided except extreme base; 2.57–3.08 mm long; width at base 0.09–0.14 mm, width at midlength 0.03 mm; aculeus length/oviscape length 0.76–0.84. Aculeus tip (Figs. 1F, 2E) length difficult to measure, 0.03–0.05 mm, width 0.02–0.03 mm; not flared outward at or proximal to base; evenly tapered with lateral margin convex, not serrate. Spermathecae (Figs. 1G) spherical to ovoid.

Male terminalia. Epandrium (Fig. 1H) in lateral view shorter than high, in posterior view without medial V-shaped indentation in posterodorsal margin. Lateral surstylus short, extended beyond prensisetae by 2.0 times length of prensiseta (although prensisetae relatively small); in posterior view short triangular, apex blunt, medial margin convex, lateral margin concave medially. Proctiger with ventral and lateral sclerotized areas narrow, separated, but without distinct depression. Phallus 4.1 mm long, 1.12 times as long as mesonotum; glans very slender.

**Type data.** The original description of *A. luederwaldti* by Lima (1934) was based on two cotypes (female and male) “ambos apanhados por [both caught by] Spitz em [in] São Paulo”, the female from Alto da Serra in “I-1926” [January 1926] and the male from Ypiranga in “XII-1925” [December 1925], deposited in the entomological collection of the “Museu Paulista” (MZUSP). We examined both specimens. The lectotype female (Figs. 3A–C), here designated to stabilize nomenclature and fix the status of this name, bears labels with the following data (Fig. 3B): “I.26” [January 1926], “São Paulo” [Brazil: São Paulo:], “Alto da Serra” [Alto da Serra de Santos, a poorly known locality that could include part of Paranapiacaba, 23°46'41”S 46°18'15”W (Francini et al. 2005)], “19.047”, “*Anastrepha luederwaldti* C. L.” “♀ 180”, red “TYPO”, a blue circle; and “Lectotype” [added by us]. It was mounted on a slender pin, which was deteriorating, and therefore was double-mounted on a block of Styrofoam. The abdomen and terminalia were mounted by Lima on a microscope slide labeled with “*A. luederwaldti* Diptera C.L.”, “do exemplar n° 180 ♀ 1933 C. L. det.” (Fig. 3C). The paralectotype male (Figs. 3D–F) has labels (Fig. 3E) with the data: “XII-25” [December 1925], “São Paulo, Ypiranga” [23°35'17”S 46°36'32”W], “19.047”, “♂ *Anastrepha luederwaldti* C. L. Type”, red “TYPO”, “♂ 180 180”, a blue circle; and “Paralectotype” [added by us]. The male genitalia and right wing were mounted by Lima on separate microscope slides (Fig. 3F) each labeled with “*Anastrepha luederwaldti* Diptera C.L. do ex. n° 180 ♂ 1933 C.L. det.”

**Other specimens examined. BRAZIL: Rio Grande do Sul:** Vacaria [28°30'S 50°56'W], 12 Sep 1995, A. Kovaleski, 1 male (USNM USNMMENT00050366); Vacaria, McPhail trap in the border of natural vegetation, 18 Dec 1995, A. Kovaleski, 1 female (ESALQ). **Santa Catarina:** Corupa, Hansa Humboldt, Dec 1946, A. Maller, 1 female (AMNH USNMMENT00105187); same, Nov 1946, 1 female (USNM USNMMENT00105188); Nova Teutonia, 27°11'S 52°23'W, 4 Dec 1937, F. Plaumann, 1 female (BMNH USNMMENT00105189).

**Host.** Unknown.

**Distribution.** Known only from southeastern and southern Brazil, the states of São Paulo, Santa Catarina, and Rio Grande do Sul.

**Comments.** This species belongs to the *punctata* group as indicated by the pair of brown spots on the posterior margin of the scutum, the shape of the lateral surstylus, the area of weakly sclerotized denticles on the eversion membrane, and the very slender and short aculeus tip. Due to the limited original description, some authors recognized the specimens from Santa Catarina and Rio Grande do Sul as a species near *A. luederwaldti*, but reexamination of the syntypes indicates that they are in fact *A. luederwaldti*.

## Acknowledgements

The following curators and institutions kindly loaned some of the specimens examined in this study: David Grimaldi (AMNH), Ian White (BMNH), and Carlos Lamas (MZUSP). We thank Lucrecia Rodriguez for assistance with some of the illustrations, and Francisco André Ossamu Tanaka who kindly took pictures in the stereomicroscope and for the permission to use the microscopes at the Núcleo de Apoio à Pesquisa em Microscopia Eletrônica Aplicada à Pesquisa Agropecuária, ESALQ/USP. USDA is an equal opportunity provider and employer.

## References

- Aczél, M.L. (1950) Catalogo de la familia 'Trypetidae' (Dipt. Acalypt.) de la región neotropical. *Acta Zoologica Lilloana*, 7, 177–328. [1949]
- Foote, R.H. (1967) Family Tephritidae (Trypetidae, Trupaneidae). In: Papavero, N. (Ed.), *A catalogue of the Diptera of the Americas south of the United States*. Vol. 57. Departamento de Zoologia, Secretaria da Agricultura, São Paulo, pp. 91.
- Francini, R.B., Freitas, A.V.L. & Brown, K.S. Jr. (2005) Rediscovery of *Actinote zikani* (D'Almeida) (Nymphalidae, Heliconiinae, Acraeini): Natural history, population biology and conservation of an endangered butterfly in SE Brazil. *Journal of the Lepidopterists' Society*, 59, 134–142.
- Kovaleski, A., Sugayama, R.L., Uramoto, K. & Malavasi, A. (2000) [Moscas-das-frutas nos estados brasileiros] Rio Grande do Sul. In: Malavasi, A. & Zucchi, R.A. (Eds.), *Moscas-das-frutas de importância econômica no Brasil. Conhecimento básico e aplicado*. Holos, Riberão Preto, pp. 285–290.
- Kovaleski, A., Uramoto, K., Sugayama, R.L., Canal D., N.A. & Malavasi, A. (1999) A survey of *Anastrepha* Schiner (Diptera, Tephritidae) species in the apple growing area of the state of Rio Grande do Sul, Brazil. *Revista Brasileira de Entomologia*, 43, 229–234.
- Lima, A.M. da Costa (1934) Moscas de frutas do genero *Anastrepha* Schiner, 1868 (Diptera: Trypetidae). *Memórias do Instituto Oswaldo Cruz (Rio de Janeiro)*, 28, 487–575.  
<http://dx.doi.org/10.1590/s0074-02761934000400002>
- Norrbom, A.L. (1985) *Phylogenetic analysis and taxonomy of the cryptostrepha, daciformis, robusta, and schausi species groups of Anastrepha Schiner (Diptera: Tephritidae)*. Dissertation, Pennsylvania State University, University Park, Pennsylvania, xvi + 354 + [1] p.
- Norrbom, A.L., Carroll, L.E., Thompson, F.C., White, I.M. & Freidberg, A. (1999a) Systematic database of names. In: Thompson, F.C. (Ed.), *Fruit Fly Expert Identification System and Systematic Information Database*. *Myia*, 9, 65–251, Diptera Data Dissemination Disk (CD-ROM). [1998]
- Norrbom, A.L., Zucchi, R.A., & Hernández-Ortiz, V. (1999b) Phylogeny of the genera *Anastrepha* and *Toxotrypana* (Trypetinae: Toxotrypanini) based on morphology. In: Aluja, M. & Norrbom, A.L. (Eds.), *Fruit flies (Tephritidae): Phylogeny and evolution of behavior*. CRC Press, Boca Raton, pp. 299–342.
- Norrbom, A.L., Korytkowski, C.A., Zucchi, R.A., Uramoto, K., Venable, G.L., McCormick, J. & Dallwitz, M.J. (2012) *Anastrepha* and *Toxotrypana*: descriptions, illustrations, and interactive keys. Version: 29 May 2012. Available from: <http://delta-intkey.com/anatox/intro.htm> (accessed 10 August 2016)
- Norrbom, A.L., Rodriguez, E.J., Steck, G.J., Sutton, B.A. & Nolasco, N. (2015) New species and host plants of *Anastrepha* (Diptera: Tephritidae) primarily from Peru and Bolivia. *Zootaxa*, 4041 (1), 1–94.  
<http://dx.doi.org/10.11646/zootaxa.4041.1.1>
- Saigusa, T. (2006) *Homology of wing venation of Diptera*. Published by the author, Fukuoka, 24 pp.
- Steyskal, G.C. (1977) *Pictorial key to species of the genus Anastrepha (Diptera: Tephritidae)*. Entomological Society of Washington, Washington, D.C., 35 pp.
- Stone, A. (1939) A new genus of Trypetidae near *Anastrepha* (Diptera). *Journal of the Washington Academy of Science*, 29, 340–350.
- Uramoto, K. & Zucchi, R.A. (1999) New species in the genus *Anastrepha* (Diptera: Tephritidae) from Brazil. *Anais da Sociedade Entomológica do Brasil*, 28, 85–89.  
<http://dx.doi.org/10.1201/9781420074468.sec8>
- White, I.M., Norrbom, A.L., Headrick, D.H. & Carroll, L.E. (1999) Glossary. In: Aluja, M. & Norrbom, A.L. (Eds.), *Fruit flies (Tephritidae): Phylogeny and evolution of behavior*. CRC Press, Boca Raton, pp. 881–924.  
<http://dx.doi.org/10.1201/9781420074468.sec8>
- Wootton, R.J. & Ennos, A.R. (1989) The implications of function on the origin and homologies of the dipterous wing. *Systematic Entomology*, 14, 507–520.  
<http://dx.doi.org/10.1111/j.1365-3113.1989.tb00300.x>
- Zucchi, R.A. (2000) Taxonomia. In: Malavasi, A. & Zucchi, R.A. (Eds.), *Moscas-das-frutas de importância econômica no Brasil. Conhecimento básico e aplicado*. Holos, Riberão Preto, pp. 13–24.